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Revision of the Subgenus *Coprochara* Mulsant & Rey of the Genus *Aleochara* Gravenhorst from Japan (Coleoptera: Staphylinidae: Aleocharinae)

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Abstract

A taxonomic revision of the subgenus *Coprochara* Mulsant & Rey, 1874 of the genus *Aleochara* Gravenhorst, 1802 in Japan is presented. The following three species are recognized: *Aleochara* (*C.*) *verna* Say, 1833, *A.* (*C.*) *binotata* Kraatz, 1856 and *A.* (*C.*) *squalithorax* Sharp, 1888, of which *A. binotata* is new to Japan. All previous records of "*A.* (*C.*) *bipustulata* (Linnaeus, 1760)" should be regarded as misidentifications of either *A. verna* or *A. binotata*. New records are added for, *A. squalithorax*, a littoral species. All species are redescribed, figured, keyed and mapped.

Key words: Aleocharini, biodiversity, identification key, redescription, rove beetle, taxonomy

Introduction

The rove beetle genus *Aleochara* Gravenhorst, 1802 is a large group in Aleocharinae, comprising more than 450 species in 19 subgenera (Park & Ahn, 2010; Yamamoto & Maruyama, 2012). *Aleochara* is distributed throughout the world, except for Antarctica (Klimaszewski, 1984; Maus *et al*., 2001). *Aleochara* is one of the taxonomically difficult groups in Coleoptera. The genus includes many large adults and commonly found species of Aleocharinae; thus, precise and simpler identification methods are required. Close similarities in external and internal structures, and cosmopolitan distributions of several species make species identification difficult.

Larvae of *Aleochara* are known to be parasitoids of cyclorrhaphous Diptera, and some species, especially members of the subgenus *Coprochara* Mulsant & Rey, 1874, are expected to be biological control agents of notorious pest flies (e.g., Klimaszewski & Jansen, 1993, 1994; Maus *et al*., 1998, 2001; Fournet *et al*., 2000). Thus, most *Aleochara* species typically occur in fly-infested habitats such as animal droppings, decaying plant material, and carrion (Klimaszweski, 1984; Yamamoto & Maruyama, 2009, 2012).

Aleochara species in Asia are far from adequately described, and taxonomic knowledge of Japanese *Aleochara* is still incomplete; only 25 species have been recorded (Bernhauer & Scheerpeltz, 1926; Smetana, 2004; Yamamoto & Maruyama, 2009, 2012).

The species of *Coprochara* have been problematic even in Europe and North America, and to date, no one has conducted a taxonomic review of the Japanese species of the subgenus. The purpose of this study, the third series of contributions to the Japanese *Aleochara* fauna, is to clarify the taxonomic identity of Japanese *Coprochara* species and to investigate geographical variation within each species. All three species are redescribed with diagnosis and figures. Diagnostic keys and distribution maps are also provided. Figures showing collection sites for two species are included.

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Materials and methods

Deposition of materials

Approximately 700 dry specimens of adult individuals were examined. Most of the material is deposited in the following public institutions and private collections.

Institutions:

BMNH	The Natural History Museum, London, UK (R. Booth).
CBM	The Natural History Museum and Institute, Chiba, Japan (A. Saitô).
KUM	The Kyushu University Museum, Fukuoka, Japan (S.-I. Naomi & S. Nomura Rove Beetle Collection, and M. Maruyama Collection) (M. Maruyama).
SCM	The Sagamihara City Museum, Kanagawa, Japan (H. Moriya).

Private collections:

cHaga	Kaoru Haga (Tôkyô, Japan).
cHay	Yasuhiko Hayashi (Hyôgo, Japan).
cIto	Tateo Itô (Kyôto, Japan).
cOno	Hiroki Ono (Chiba, Japan).
cShi	Yasutoshi Shibata (Tôkyô, Japan).
cWat	Takashi Watanabe (Kanagawa, Japan).
cWatY	Yasuaki Watanabe (Tôkyô, Japan).
cYam	Shûhei Yamamoto (Fukuoka, Japan).

Measurements and terminology

The technical procedures, terminology, and other methods adopted here were given in detail in Maruyama (2006) and Yamamoto and Maruyama (2012). Words for genital parts were adopted mainly from Welch (1997) and Maus (1998).

The specimen data used in this study largely did not follow the original spellings and place names written on specimen labels. We corrected for more precise and detailed information, except for some type materials. The original spellings on the label attached to the specimen were adopted in such cases (after Yamamoto & Maruyama, 2012).

Abbreviations for morphology and materials

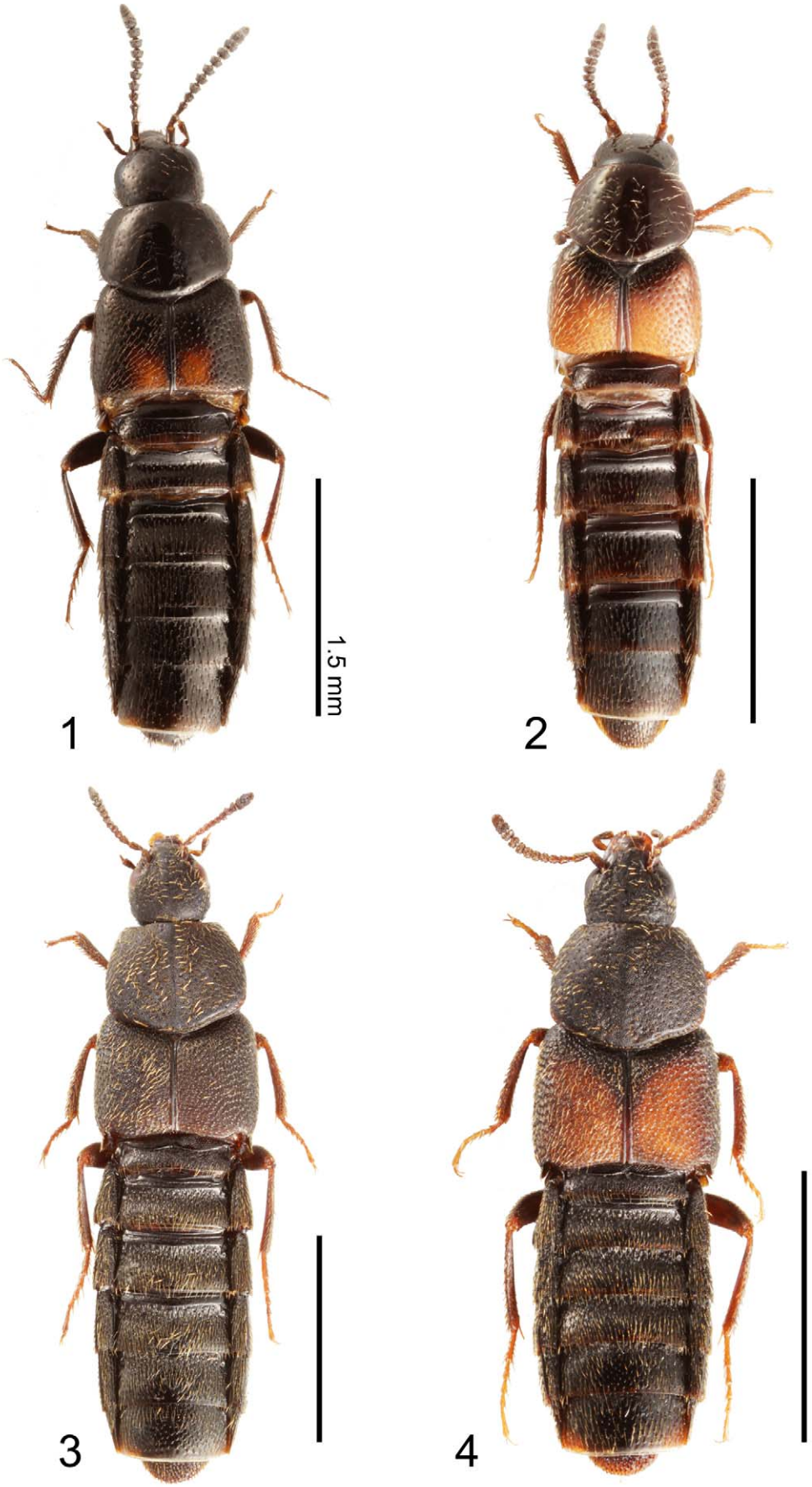
Genital structures are abbreviated as follows: ai, apical invagination of spermatheca; bs, basal swelling of median lobe; sa, apical portion of spermathecal stem; sb, basal portion of spermathecal stem; sga, attachment of spermathecal duct; sh, head of spermatheca; sm, membranous portion of spermathecal duct; and sn, neck of spermatheca (after Welch, 1997: Figs. 1, 4; see Figs. 18, 21, 29 in the present paper).

Conditions of specimen labels are abbreviated as follows: HW, hand written; PC, paper card; PRL, purple round label pinned by a curator; RRL, red round label pinned by a curator.

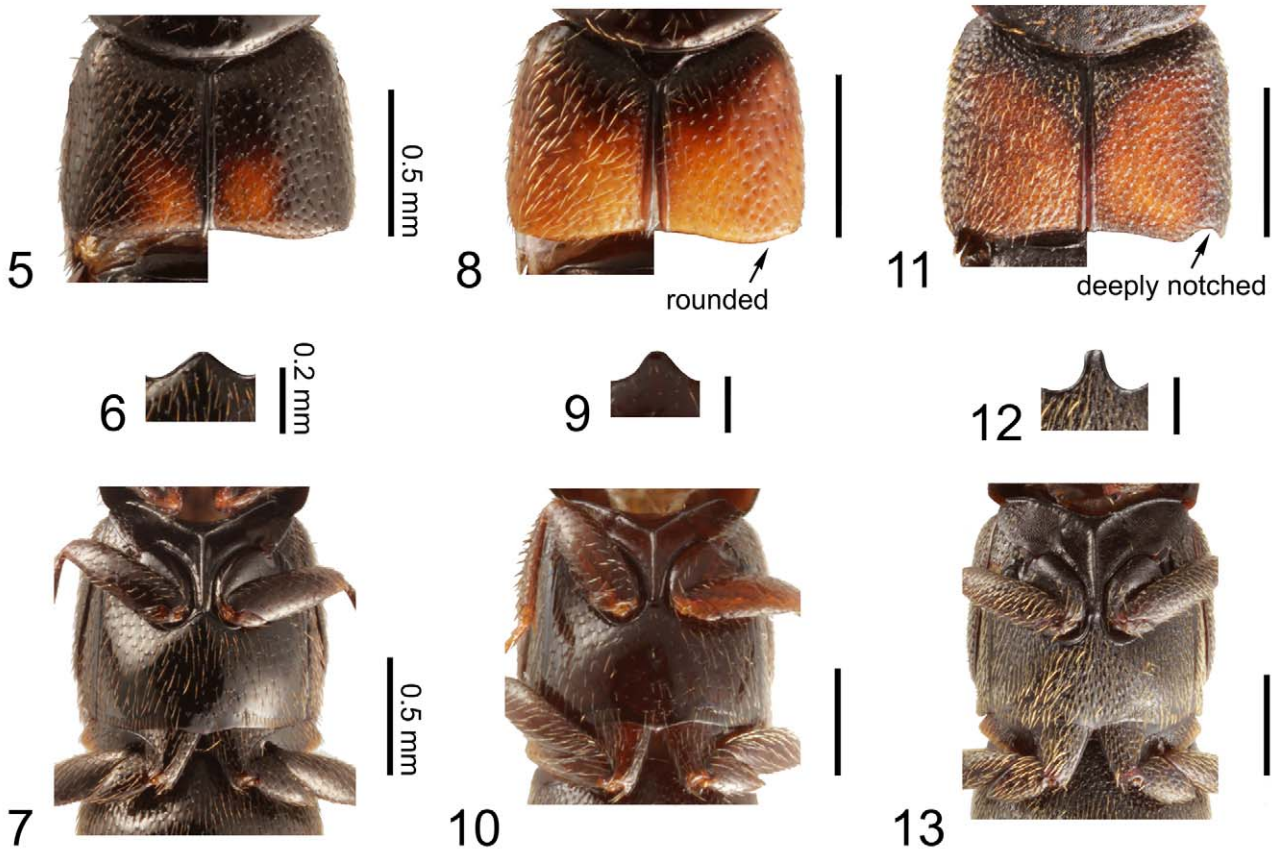
Elytral color variations in *Aleochara squalithorax* are abbreviated as follows: GT, gray type; YT, yellow type.

Glossary of Japanese local names

Japanese place names generally follow the same spelling used in Japan except for some English nouns. Words nearly correspond as follows: -mura (village); -chô, -machi (town); -ku (ward/district); -shi (city); -gun (county); -to, -fu, -ken (prefecture); -dake, -take, -san, -zan, -yama (mountain); -misaki, -zaki (cape); -gawa (river, stream); -kaigan, -hama (seashore beach); -shima (island); -shotô (islands, archipelago).



FIGURES 1–4. Japanese species of *Aleochara* (*Coprochara*) in habitus. 1. *Aleochara* (*Coprochara*) *verna*; 2. *A.* (*C.*) *binotata*; 3–4. *A.* (*C.*) *squalithorax*: gray type (Fig. 3) and yellow type (Fig. 4).



FIGURES 5–13. Japanese species of *Aleochara* (*Coprochara*). 5–7. *Aleochara* (*Coprochara*) *verna*; 8–10. *A.* (*C.*) *binotata*; 11–13. *A.* (*C.*) *squalithorax*. (5, 8, 11: elytra; 6, 9, 12: intercoxal process of metaventrite; 7, 10, 13: mesoventrite and metaventrite).

Systematics

Genus *Aleochara* Gravenhorst, 1802

See Klimaszewski (1984), Smetana (2004), and Gouix and Klimaszewski (2007) for synonymic information and references. A detailed description is provided by Klimaszewski (1984) and a short description is provided by Yamamoto and Maruyama (2012).

Subgenus *Coprochara* Mulsant & Rey, 1874

Coprochara Mulsant & Rey, 1874: 146; Klimaszewski, 1984: 14; Lohse, 1989: 236; Klimaszewski & Jansen, 1994: 148; Welch, 1997: 3; Maus, 1998: 83; Maus & Ashe, 1998 (online); Klimaszewski *et al*., 2000: 237; Smetana, 2004: 355; Gouix & Klimaszewski, 2007: 23.
Baryodma Thomson, 1858: 31.
Eucharina Casey, 1906: 165. [homonym].
Funda Blackwelder, 1952: 166. [replacement name].
Mecorhopalus Solier, 1849: 347.
Skenochara Bernhauer & Scheerpeltz, 1926: 795.
See Klimaszewski (1984) and Maus (1998) for further references.

Type species: *Aleochara bilineata* Gyllenhal, 1810.

Diagnosis. The subgenus *Coprochara* can be distinguished from the other subgenera of *Aleochara* by the combination of following character states (see details in Klimaszewski, 1984; Klimaszewski & Jansen, 1994; Maus, 1998): antennae thick with segments V–X clearly transverse; two longitudinal, parallel or subparallel rows of more or less impressed punctures on midline of pronotum; elytra in some species with orange or yellow spot; mesoventrite with complete carina; spermatheca usually multiply coiled posteriorly, varying from 1 to more than 100 coils; median lobe of aedeagus with flagellum and distinctively arranged sclerites (Figs. 18–19), lacking subapico-ventral projections (see Yamamoto & Maruyama, 2012: Fig. 18).

Remarks. The subgenus *Coprochara* includes 37 species worldwide and 18 species from the Palearctic region (Maus, 1998, 2000; Smetana, 2004). This subgenus is widely distributed in all zoogeographical regions (Klimaszewski, 1984). The taxonomy of the subgenus *Coprochara* is difficult due to external similarity, considerable variation within species, and incorrect interpretations of the configuration of male genitalia (Maus, 1998). For example, species identifications in England were confused until the late 1980s (Welch, 1990, 1997).

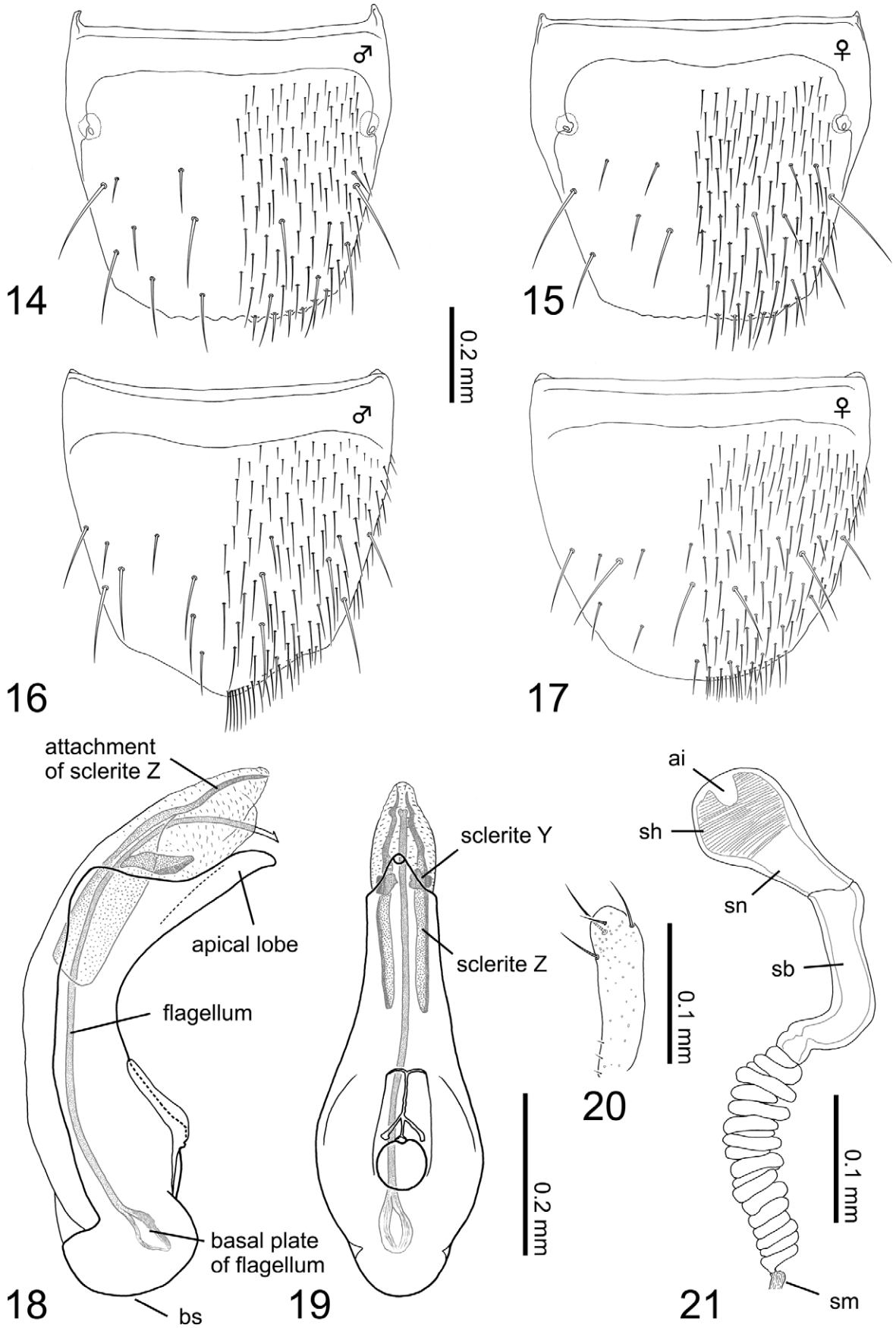
Despite these taxonomic difficulties, species belonging to the subgenus have attracted special attentions as biological control agents for pest flies. Most studies on the subgenus have used *A.* (*C.*) *bilineata* Gyllenhal, 1810, *A.* (*C.*) *bipustulata* (Linnaeus, 1760), and *A.* (*C.*) *verna* Say, 1833. One advantage of using the subgenus *Coprochara* for biological control is that they are native species within a wide distribution range, which reduces ecological impact on ecosystems.

Phylogenetic relationships among species of the subgenus *Coprochara* are relatively well known. Maus and Ashe (1998), based on morphological characters, and Maus *et al*. (2001), based on molecular data, produced phylogenetic trees for the subgenus. However, Maus and Ashe (1998) noted difficulties in the examination of phylogenetic relationships within the subgenus, such as the high frequencies of parallelism and homoplasy in the group, and most of the apomorphic character states have evolved independently in different lineages within the subgenus.

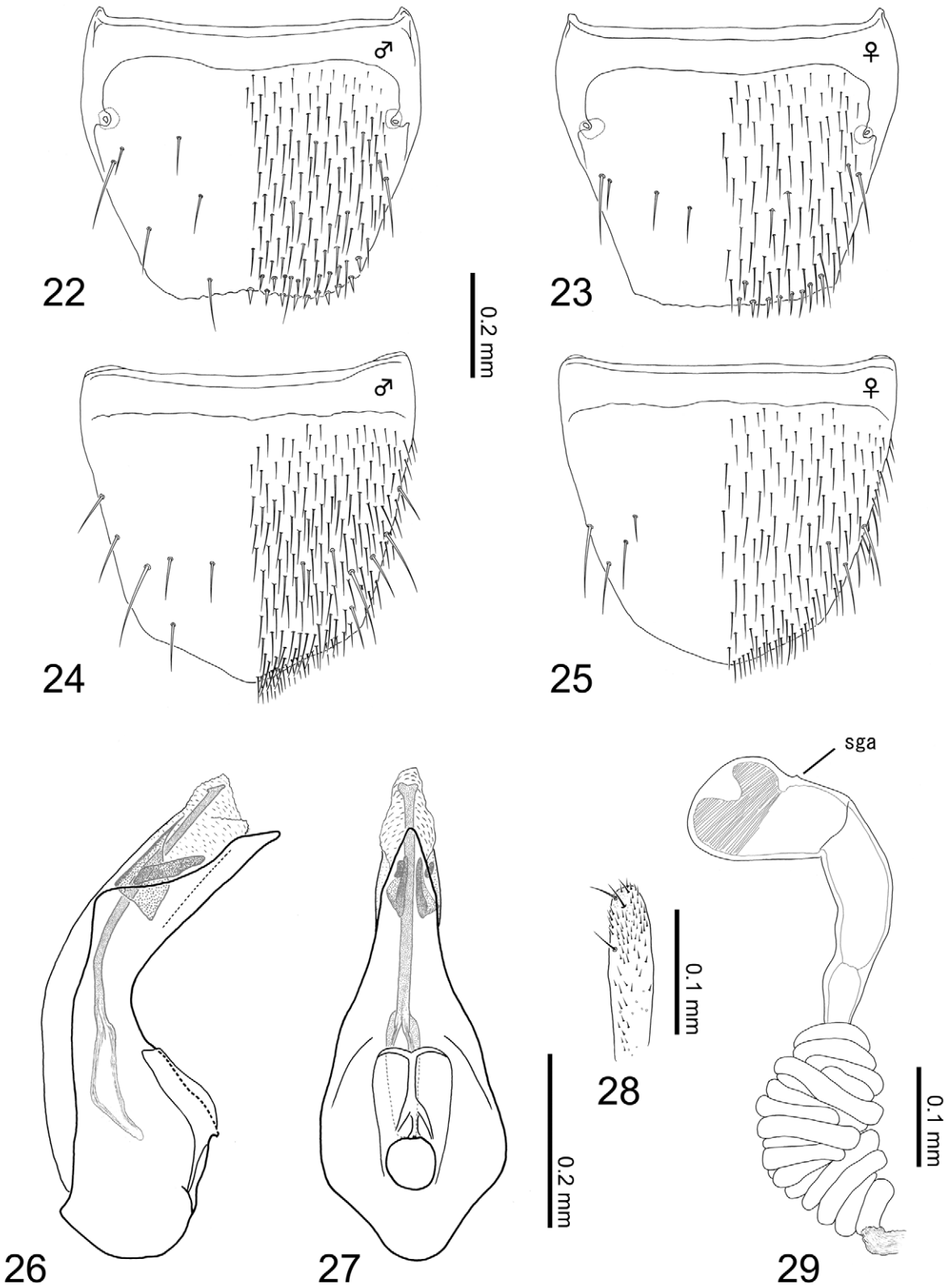
Three species of the subgenus *Coprochara* have been recorded in Japan, *A. bipustulata*, *A. squalithorax* Sharp, 1888, and *A. verna*, the latter reliably only from Gunma and Kanagawa Prefectures (Maus, 1998; Park *et al*., 2011). "*Aleochara bipustulata*", on the other hand, has been widely recorded from Japan. The littoral species, *A. squalithorax* was originally described from Hokkaidô and Honshû (Sharp, 1888).

Key to species from the subgenus *Coprochara* in Japan

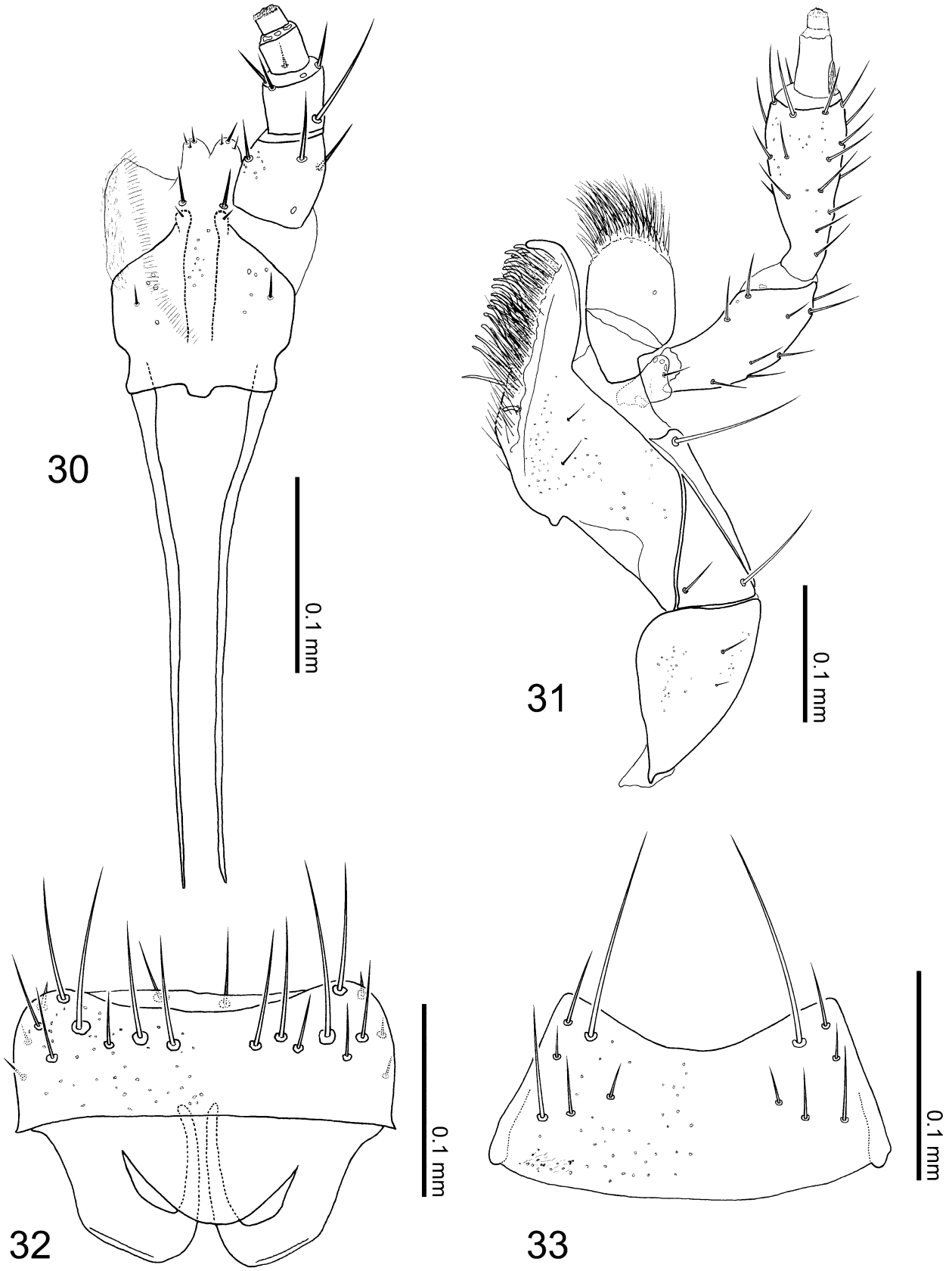
1. Body (Figs. 3–4) gray, thick, spindle shaped; dorsal surface covered with granular microstructures and forebody not glossy at all. Intercoxal process of metaventrite (Figs. 12–13) narrow and long, pointed apically. Elytra (Fig. 11) with posterior margins deeply notched laterally; surface rough, densely covered with short but robust setae. Tergite VIII (Figs. 34–35) with numerous large oval projections on surface. Collected from decaying seaweed on seashore beach. [**Male**]: median lobe of aedeagus as in Figs. 38–39; sclerite Z large, without attachment at apex; flagellum longer than median lobe of aedeagus. [**Female**]: proximal portion of spermatheca (Fig. 41) with extremely numerous coils. . . . . *Aleochara* (*Coprochara*) *squalithorax* Sharp, 1888
- Body black to blackish brown, slender, parallel or subparallel sided; dorsal surface not covered with granular microstructures, and clearly glossy. Intercoxal process of metaventrite wide and rounded apically. Elytra with posterior margins rounded, usually with yellowish portion. Tergite VIII without large oval spines on surface, with serrate or truncate posterior margin. Spermatheca proximally with 20 coils at most 2
2. Dorsal surface smooth and apparently glossy (Fig. 1). Pronotum with shallow and inconspicuous punctures and with thin setae. Two rows of punctures along midline fine. Elytra (Fig. 5) with a pair of small reddish to yellowish spots near posterior margin and suture, bearing with numerous thin and inconspicuous setae. Common species in Japan. [**Male**]: sternite VIII (Fig. 16) simple and weakly pointed. Median lobe of aedeagus (Figs. 18–19): apex of apical lobe of median lobe blunt in lateral view; flagellum long, slightly longer than median lobe of aedeagus; sclerite Z large, with long and prominent attachment, waving toward apex. [**Female**]: coiled portion of spermatheca (Fig. 21) not greatly extended laterally. . . . . *A.* (*C.*) *verna* Say, 1833
- Body more slender. Elytra entirely yellow except for anterior margins near pronotum (Japanese specimens). 3
3 Dorsal surface with distinct and deep coarse punctures, and with thick yellowish setae (Fig. 2). Pronotum with distinct punctures and rows of deep punctures along midline. [**Male**]: sternite VIII (Fig. 24) pointed triangularly. Median lobe of aedeagus (Figs. 26–27): apex of apical lobe sharply pointed in lateral view; flagellum short, but basal plate of flagellum long and large; sclerite Z small, with straight attachment pointed toward apex. In Japan known only from Hokkaidô. [**Female**]: proximal portion of spermatheca (Fig. 29) with thick coils and widely extended laterally. . . . . *A.* (*C.*) *binotata* Kraatz, 1856



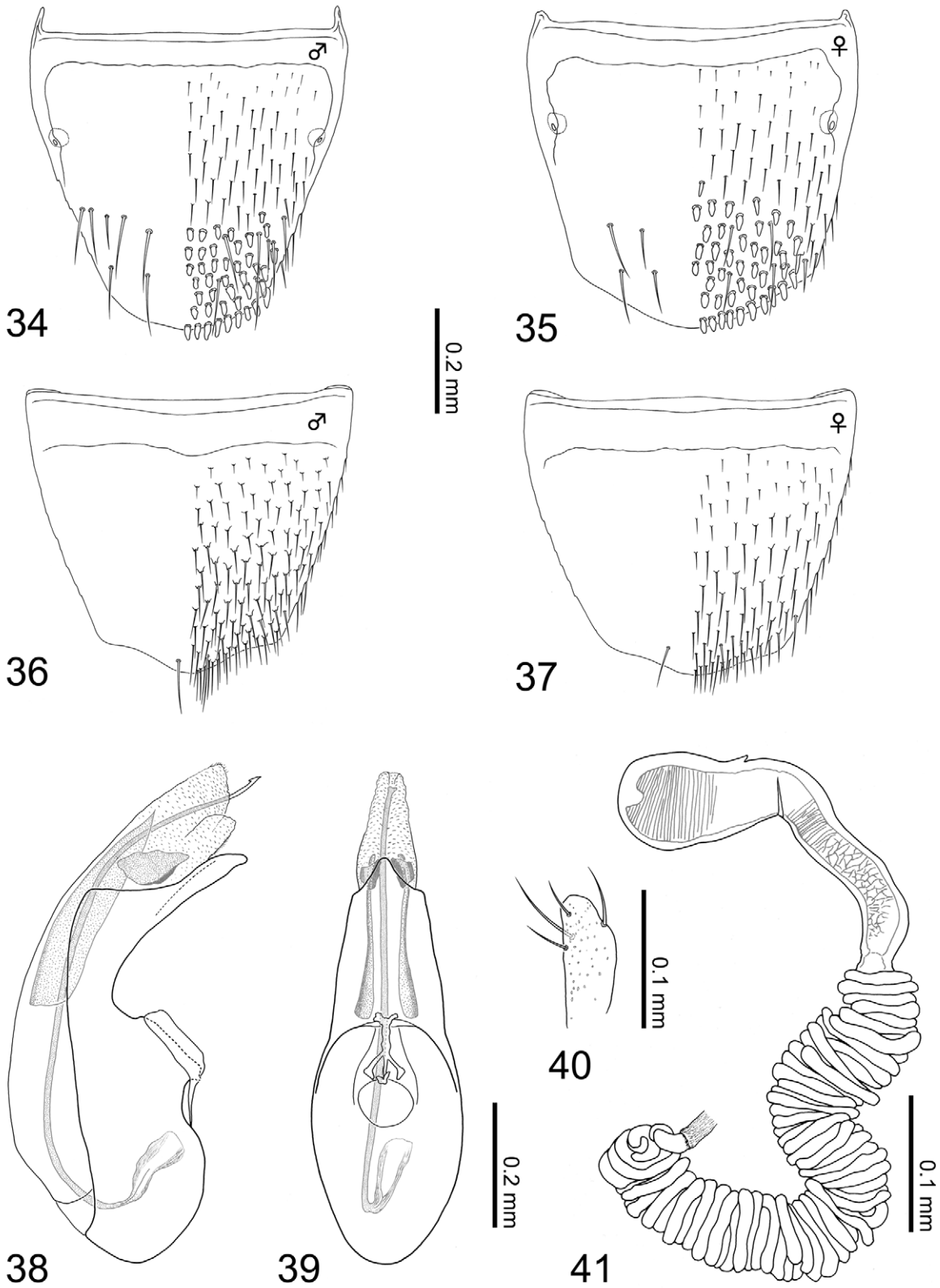
FIGURES 14–21. Terminalia of *Aleochara* (*Coprochara*) *verna*. 14. tergite VIII of male; 15. tergite VIII of female; 16. sternite VIII of male; 17. sternite VIII of female; 18. male genitalia: median lobe of aedeagus in lateral view; 19. male genitalia: median lobe of aedeagus in ventral view; 20. apical lobe of paramerite, lateral view; 21. female genitalia: spermatheca.



FIGURES 22–29. Terminalia of *Aleochara* (*Coprochara*) *binotata*. 22. tergite VIII of male; 23. tergite VIII of female; 24. sternite VIII of male; 25. sternite VIII of female; 26. male genitalia: median lobe of aedeagus in lateral view; 27. male genitalia: median lobe of aedeagus in ventral view; 28. apical lobe of paramerite, lateral view; 29. female genitalia: spermatheca.



FIGURES 30–33. Mouth parts of *Aleochara* (*Coprochara*) *squalithorax* of male. 30. labium; 31. maxilla; 32. labrum; 33. mentum.



FIGURES 34–41. Terminalia of *Aleochara* (*Coprochara*) *squalithorax*. 34. tergite VIII of male; 35. tergite VIII of female; 36. sternite VIII of male; 37. sternite VIII of female; 38. male genitalia: median lobe of aedeagus in lateral view; 39. male genitalia: median lobe of aedeagus in ventral view; 40. apical lobe of paramerite, lateral view; 41. female genitalia: spermatheca.

Results

Aleochara (*Coprochara*) *verna* Say, 1833

Figs. 1, 5, 7, 14, 21, 42, 44

Aleochara (*Coprochara*) *verna*; Say, 1833: 58 (original description); Klimaszewski, 1984: 22; Lohse, 1986: 95; Lohse, 1989: 239; Welch, 1997: 3, 14; Maus, 1998: 87, 96; Maus *et al*., 1998: 241; Maus & Ashe, 1998 (online); Naomi *et al*., 2000: 107; Maus *et al*., 2001: 205; Smetana, 2004: 356; Gouix & Klimaszewski, 2007: 25; Park *et al*., 2011.
Aleochara languida Sachse, 1852: 117.
Baryodma pauxilla Mulsant & Rey, 1874: 159.
Aleochara alticola Sharp, 1883: 148.
Baryodma minuta Casey, 1906: 161. [homonym].
Baryodma pumilio Casey, 1911: 6.
Baryodma tolerata Casey, 1911: 6.
Aleochara tecumsehi Muona, 1977: 16. [replacement name].
Aleochara tanumi Likovský, 1984: 8. [replacement name].
Aleochara cedari Likovský, 1984: 8. [replacement name].
"*Aleochara bipustulata*"; Sharp, 1888: 282 (as *Aleochara nitida* Gravenhorst, a synonym of *A. bipustulata*); Adachi, 1957: 34; Naomi, 1989: 280; Smetana, 2004: 355.
See Klimaszewski (1984) and Gouix & Klimaszewski (2007) for further references.

Materials examined. JAPAN: [**Hokkaidô**]: 1 ♂, Memuro-dake (Penkenûshi-dake), Shimizu-chô, Kamikawa-gun, 15. VII. 1995, K. Haga leg. (cHaga); 1 ♂, 1 ♀, Shari-dake, Shari-machi, Shari-gun, 23. VII. 1996, K. Mizota leg. (KUM). [**Honshû**]: 1 ♂, Matsugabô-dam, Yamakami, Sôma-shi, Fukushima-ken, 20. XII. 2006, S. Saitô leg. (leaf litter in forest; cWat); 1 ♀, Azuma-yama, Inawashiro-machi, Yama-gun, Fukushima-ken, 19. VIII. 1996, S.-I. Naomi leg. (KUM); 2 ♂♂, Ômomo, Minamiaizu-machi, Aizu-gun, Fukushima-ken, 23. VI. 1990, T. Watanabe leg. (cWat); 1 ♂, 2 sex?, Maeshirane-san, Chûgushi, Nikkô-shi, Tochigi-ken, 23. VI. 1990, T. Watanabe leg. (cWat); 4 sex?, Yumoto, Nikkô-shi, Tochigi-ken, 29. VI. 1982, S.-I. Naomi leg. (KUM); 1 sex?, same data, but 10. VII. 1994; 2 sex?, Chûzenji, Nikkô-shi, Tochigi-ken, 28–30. VI. 1982, S.-I. Naomi leg. (KUM); 1 ♀, Akagi-san (Komagatake peak), Fujimi-mura, Seta-gun, Gunma-ken, 20. VII. 1996, S. Nomura leg. (KUM); 1 ♀, Hôshi-onsen hotspring, Minakami-machi, Tone-gun, Gunma-ken, 26. VI. 1997, S.-I. Naomi leg. (KUM); 2 ♂♂, 6 ♀♀, Akaguna-yama, Kamihino, Fujioka-shi, Gunma-ken, 13. IX. 2001, T. Watanabe leg. (cWat); 1 ♂, same data, but 15. V. 2002; 1 ♂, Watarase-yûsuichi retarding basin, Fujioka-shi, Tochigi-ken, 13. IV. 2002, T. Watanabe leg. (cWat); 3 ♂♂, 3 ♀♀, Matsuzawa-tôge pass (alt. 1150m), Haruna-san, Takasaki-shi, Gunma-ken, 27. VII. 1996, S. Nomura leg. (KUM); 3 ♂♂, Nidoage-tôge pass, Kawaura, Kurabuchi-machi, Takasaki-shi, Gunma-ken, 11. IX. 2002, T. Watanabe leg. (cWat); 6 sex?, Kanaibuchi-machi, Takasaki-shi, Gunma-ken, 27. III. 2005, T. Watanabe leg. (cWat); 1 ♂, 7 sex?, Wagamine-machi, Takasaki-shi, Gunma-ken, 27. III. 2005, T. Watanabe leg. (cWat); 1 ♂, Kirizumi, Sakamoto, Matsuida-machi, Annaka-shi, Gunma-ken, 19. VIII. 1962, Y. Shibata leg. (cShi); 3 ♂♂, 3 ♀♀, Kamioshidari, Higashimatsuyama-shi, Saitama-ken, 1. XI. 1998, K. Toyoda leg. (KUM); 1 ♂, Tenmoku-zan, Chichibu-shi, Saitama-ken, 12. VI. 1998, K. Toyoda leg. (KUM); 3 ♀♀, Hirogawarasawa, Nakatsugawa, Chichibu-shi, Saitama-ken, 11. X. 1999, K. Toyoda leg. (KUM); 1 ♀, Tone-gawa, Sakae-machi, Inba-gun, Chiba-ken, 5. V. 1991, T. Takeda leg. (KUM); 1 ♀, Amatsu-kaigan, Uchiura, Kamogawa-shi, Chiba-ken, 3. XI. 1990, T. Takeda leg. (KUM); 1 ♀, Heisaura, Sakai, Tateyama-shi, Chiba-ken, 1. IV. 1997, M. Maruyama leg. (KUM); 1 sex?, river mouth of Obitsu-gawa, Kuroto, Kisarazu-shi, Chiba-ken, 25. X. 1998, K. Toyoda leg. (KUM); 1 sex?, Takao-san, Hachiôji-shi, Tôkyô-to, 16. IV. 1962, Y. Shibata leg. (cShi); 1 ♀, Arasaki, Nagai, Yokosuka-shi, Kanagawa-ken, 17. XI. 1963, Y. Shibata leg. (cShi); 1 sex?, Hayama-machi, Miura-gun, Kanagawa-ken, 27. III. 1953, R. Kiryû leg. (SCM); 1 sex?, Kamimizo, Chuô-ku, Sagamihara-shi, Kanagawa-ken, 23. V. 1954, R. Kiryû leg. (SCM); 1 ♂, Shônan-kaigan, Kanagawa-ken, 2. VII. 1976, Niizato leg. (without collector's given name; KUM); 1 ♀, Mitsuishi (Manazuru-misaki), Manazuru-machi, Ashigarashimo-gun, Kanagawa-ken, 15. VII. 1989, T. Watanabe leg. (under rubbish on the beach; cWat); 1 ♀, Susugaya (Tanzawayamafudakake), Kiyokawa-mura, Aikô-gun, Kanagawa-ken, 6. XI. 1993, T. Watanabe leg. (cWat); 1 ♂, 1 sex?, Tônosawa, Hakone-machi, Ashigarashimo-gun, kanagawa-ken, 24. X. 1971, Y. Hirano leg. (KUM); 1 ♀, Usui-tôge, Karuizawa, Karuizawa-machi, Kitasaku-gun, Nagano-ken, 31. VII. 1999, S.-I. Naomi leg. (KUM); 13 sex?, Kamihikawa, Daibosatsu, Kôshû-shi, Yamanashi-ken, 14. VI. 1986, T. Watanabe leg. (cWat); 4 ♂♂, 1 ♀, near Tsuchimuro-gawa, Daibosatsu, Yamanashi-ken, 16–17. X. 1982, Y. Shibata leg. (cShi); 1 sex?, Hôoh-goya lodge, Minamiarupusu-shi, Yamanashi-

ken, 26. VII. 1967, Y. Shibata leg. (cShi); 1 ♀, same locality, 11. VI. 1990, K. Hosoda leg. (cIto); 1 ♀, same data, but 2. VI. 1993; 1 sex?, Hirogawara (Shirane-san), Minamiarupusu-shi, Yamanashi-ken, 9–13. VII. 1982, S.-I. Naomi leg. (KUM); 1 ♂, 2 sex?, Yanbushi-tôge pass, Hayakawa-chô, Minamikoma-gun, Yamanashi-ken, 4. VII. 2002, A. Sugimura leg. (KUM); 1 ♀, 1 sex?, river mouth of Yodo-gawa, Ôsaka-shi, Ôsaka-fu, 17. III. 1956, Y. Hayashi leg. (cHay). [**Shikoku**]: 1 ♂, 2 ♀♀, 1 sex?, Ôtaki-san, Shionoe-chô, Takamatsu-shi, Kagawa-ken, 8. VI. 2008, H. Fujimoto leg. (KUM); 2 ♂♂, Tsurugi-san, Tokushima-ken, 19–20. VI. 1981, S.-I. Naomi leg. (KUM). [**Kyûshû**]: 1 ♂, 19 sex?, Shakaga-dake (alt. 1200m), Yame-shi, Fukuoka-ken, 25. IX. 1994, S. Nomura leg. (KUM); 2 sex?, Sobo-san, Ôita-ken, 19. VII. 1985, K. Ogata leg. (KUM); 1 ♂, 2 ♀♀, 1 sex?, Sobo-san, Taketa-shi, Ôita-ken, 7. VI. 2009, S. Yamamoto leg. (daytime on walkway; cYam); 13 sex?, same data, but 14. VII. 2011 (besides these records, dozens of individuals were observed (only field observation, no collecting permit) at the top of the mountain which is situated on a boundary of Ôita-ken and Miyazaki-ken: Fig. 42); 3 ♀♀, 2 sex?, Kurokawa, Aso-shi, Kumamoto-ken, 6. VI. 2009, S. Yamamoto leg. (from cow dung on pasture during daytime; cYam); 1 ♂, 1 ♀, Ichifusa-yama, Mizukami-mura, Kuma-gun, Kumamoto-ken, 1–2. VIII. 1988, S.-I. Naomi leg. (KUM); 1 ♀, Tomioka (Amakusa-syotô), Reihoku-machi, Amakusa-gun, Kumamoto-ken, 3. IV. 1977, S.-I. Naomi leg. (KUM); 1 ♂, Nichinan-shi, Miyazaki-ken, 29. V. 1969, Watanabe leg. (without collector's given name; KUM); 1 ♀, Wanitsuka-yama, Kou, Tano-chô, Miyazaki-shi, Miyazaki-ken, 6. IX. 1993, S. Nomura leg. (KUM); 1 sex?, Kirishima-yama, Kobayashi-shi, Miyazaki-ken, 4. VII. 1982, M. Takanashi leg. (KUM); 1 ♂, Takachiho, Miyazaki-ken, 24. VI. 1969, Y. Goto leg. (cShi); 28 sex?, Takachihonomine, Miike-chô, Miyakonojô-shi, Miyazaki-ken, 21. V. 1982, H. Takemoto leg. (KUM); 1 sex?, same locality, 19. VII. 1983, M. Ôhara leg. (KUM); 8 sex?, Takachihonomine, 31. V. 1981, Y. Takai leg. (KUM); 5 sex?, same locality, ? VIII. 1979, Koda leg. (without detail collecting date and collector's given name; KUM); 1 ♀, 19 sex?, Takachihonomine, kirishimataguchi, Kirishima-shi, Kagoshima-ken, N. Koda leg. (without collecting date; KUM); 1 ♂, 1 ♀, 3 sex?, Kirishima-yama (near Miike pond), Kagoshima-ken, 18. V. 1983, Y. Sawada leg. (KUM); 1 ♂, Unzen-dake, Unzen-shi, Nagasaki-ken, 17. V. 1986, T. Itô leg. (cIto); 3 sex?, same locality, 3. VII. 1977, S. Imasaka leg. (KUM); 1 ♀, same data, but 4. VII. 1978; 1 ♂, 1 sex?, same data, but 24. VI. 1979; 1 ♀, same data, but 5. VIII. 1980; 1 ♀, same data, but 24. VI. 1981.

Other material. RUSSIA: [**Kamchatka Peninsula**]: 1 ♀, Nagornyi (53°07'N 158°31'E), near Petropavlovsk-Kamachatskiy, 10. VII. 1997, A. Saitô leg. (Naomi *et al.*, 2000; CBM: CBM-ZI/81531).

Redescription. Body (Fig. 1): slender and subparallel, normally moderate in size, ca. 3.63 mm in body length (3.12–4.32 mm, N = 15), and 1.72 mm in fore body length (1.41–1.83 mm, N = 15), robust, and dorsal surface clearly glossy. **Color** (Figs. 1, 5–7): ground color completely black; legs, especially tarsal segments, and mouth parts brown to reddish brown; elytra with a pair of yellowish spots; antennae blackish brown to reddish brown, surface moderately to densely pubescent with minute whitish setae. **Head** (Fig. 1): circular (head length = 0.47–0.57 mm (mean = 0.53 mm), head width = 0.49–0.63 mm (mean = 0.57 mm), N = 15), slightly transverse (head width / head length = 1.08 (mean), N = 15), widest at eyes; surface covered with long and thin setae sparsely, punctation shallow and inconspicuous. **Antennae** (Fig. 1): moniliform, thick and robust, shorter than head and pronotum combined (antenna length = 0.74–0.95 mm (mean = 0.87 mm), N = 15); segment I, about 2.3 times as long as broad, segment II clearly shorter than I, segment III slightly shorter than II, segment IV spherical, as long as width except for stem of segment, segments V to X clearly transverse, segment XI thick and subconical, nearly 1.8 times as long as width, longer than segment I, approximate relative length of segments from basal to apex: 12.0: 10.5: 7.5: 4.0: 4.5: 5.0: 5.0: 5.0: 5.0: 5.0: 15.0. **Thorax**: pronotum (Fig. 1) moderately transverse (pronotum length = 0.54–0.79 mm (mean = 0.65 mm), pronotum width = 0.68–0.91 mm (mean = 0.84 mm), pronotum width / pronotum length = 1.29 (mean), N = 15), wider than head (pronotum width / head width =1.49 (mean), N = 15), widest just after middle; surface coarsely and shallowly punctured, with weak longitudinal rows of punctures along midline. Intercoxal process of mesoventrite (Fig. 7) with strong carina along midline. Intercoxal process of metaventrite (Figs. 6–7) broad and short, rounded apically. Metaventrite (Fig. 7) smooth, pubescent like elytra. Elytra (Fig. 5) wider than long (elytra length = 0.54–0.70 mm (mean = 0.62 mm), elytra width = 0.77–1.11 mm (mean = 0.98 mm), N = 15) with a pair of yellowish small spots extending from posterior margin close to elytral suture; surface shallowly punctured and with inconspicuous setae; posterior margin weakly rounded. **Legs** (Fig. 1): short (hind tibia length = 0.44–0.65 mm (mean = 0.55 mm), N =15), dozens of long spines on fore and midtibia, respectively; relative lengths of tarsal segments from basal to apical: 4.5: 3.0: 3.0: 3.0: 8.5 in foretarsus, 9.0: 5.0: 5.0: 5.0: 11.0 in midtarsus, 13.0: 8.0: 8.0: 8.0: 14.5 in hindtarsus. **Abdomen** (Fig. 1): weakly glossy, covered by short and thin setae. **[Male]**: posterior margin of tergite VIII (Fig. 14) clearly serrate, with approximately 8

macrosetae on each side. Sternite VIII (Fig. 16) with approximately 8 macrosetae; posterior margin pointed triangularly. Median lobe of aedeagus as in Figs. 18–19: elongated and narrowed toward apex; flagellum inside projecting, longer than median lobe of aedeagus; basal plate of flagellum small and short; sclerite Z with long attachment, waving apically; apical lobe in lateral view moderately bent, narrowing subapically; basal swelling of median lobe circularly rounded; median lobe in ventral view moderately tear-shaped; basal swelling of median lobe small; apical lobe looks short isosceles. Apical lobe of paramerite (Fig. 20) long and slender, bearing 4 long setae.

[Female]: tergite VIII (Fig. 15) with weakly serrate posterior margin, with 7 macrosetae. Sternite VIII (Fig. 17) rounded posteriorly, with 8 macrosetae. Spermatheca (Fig. 21): apical invagination of spermatheca small but deep; spermathecal head spherical, as long as spermathecal neck; attachment of spermathecal duct inconspicuous; (sn) clearly narrowing toward basal portion of spermathecal stem, stem moderately curved to almost angled at its base; coiled portion of moderate length, composed of maximally 20 thin coils, not strongly extended laterally; coils directly connected with thin membranous portion of spermathecal duct; each part of spermatheca except for (sm) entirely and moderately sclerotized; inner wall of (sh) finely striate.

Diagnosis. This species is similar to the other Japanese species of the subgenus *Coprochara*, but can be easily distinguished from them by the following character states: surface smooth and glossy (Fig. 1); elytral posterior margin rounded with a pair of yellowish spots on dorsal surface of elytra (Figs. 1, 5); intercoxal process of metaventrite moderately rounded apically (Figs. 6–7); tergite VIII without thick spines in posterior half (Figs. 14–15). [**Male**]: sclerite Z inside the median lobe with long waving attachment at apex (Figs. 18–19). [**Female**]: spermatheca with maximally 20 thin coils, not greatly extended laterally (Fig. 21).

Confirmed distribution by the present study. [**JAPAN**]: Hokkaidô, Honshû, Shikoku, Kyûshû, [**RUSSIA**]: Kamchatka Peninsula.

Other localities in the literature. [**EUROPE**]: Austria, Azerbaijan, Azores, Belgium, Bosnia Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, France, Georgia, Germany, Greece, Hungary, Italy, Lithuania, the Nertherlands, Poland, Portugal, Romania, Russia: South European Territory, Slovakia, Spain, Sweden, Switzerland, UK, Ukraine (Maus, 1998; Smetana, 2004; Assing, 2006; Prado e Castro *et al*., 2010; Tamutis *et al*., 2011), [**NORTH AFRICA**]: Algeria, Canary Islands, Egypt, Libya, Morocco, Madeira Archipelago (Smetana, 2004), [**ASIA**]: Afghanistan, China, India, Iran, Israel, Kazakhstan, Mongolia, Nepal, North Korea, Russia: Far East, South Korea, Syria, Tajikistan, Turkmenistan, Turkey, Uzbekistan (Maus, 1998; Smetana, 2004; Park *et al*., 2011), [**NORTH AMERICA**]: Alaska, Canada, Hawaii, Mexico, USA (Klimaszewski, 1984; Navarrete *et al*., 2002; Gouix & Klimaszewski, 2007), [**SOUTH AMERICA**]: Venezuela (Navarrete *et al*., 2002).

Remarks. *Aleochara verna* is very common and widely distributed in the Holarctic region. The distribution ranges through all of Europe and North Africa, across northern India and the Russian Far East to North America (Maus, 1998; Smetana, 2004). In Japan, reliable records had been reported from only two localities, Gunma and Kanagawa Prefectures (Maus, 1998; Park *et al*., 2011). Numerous records are added from all of Japan, from northern Hokkaidô to southern Kyûshû, Japan.

This species was originally described from Missouri, USA. As the type specimen was destroyed, the neotype was designated by Klimaszewski (1984). The distribution of this species in the Palearctic region is unclear; it has been suggested that *A. verna* is not a Nearctic, but a Palearctic species (Maus, 1998).

The taxonomic status of *A. verna* was unstable until Lohse (1986) and thus far several cases of confusion have occurred, e.g., misidentifications of species in Europe and the proposed use of many synonyms for some species and subspecies under *A. verna* (Klimaszewski, 1984; Welch 1997; Maus, 1998). Recent studies such as Welch (1990, 1997) and Maus (1998) have allowed the precise identification of the *Coprochara*-complex, including *A. verna*, in the Palearctic region.

The Japanese specimens examined have a blackish body with a pair of small yellow markings on the elytra; no geographical variations were detected. This species is commonly found in Japan; many records have been reported as "*Aleochara bipustulata*". However, true specimens of *A. bipustulata* were not found in the present study. Therefore, the distribution of *A. bipustulata* in Japan is doubtful and it should be excluded from the Japanese fauna (see Discussion).

Park *et al*. (2011) redescribed and recorded *A. verna* from South Korea, with diagnoses of *A. verna* and "*A. bipustulata*". Following the Japanese example, Korean specimens of "*A. bipustulata*" should be reexamined.

In Japan, *Aleochara verna* might be the most efficient candidate as a biological control agent due to its abundance, and wide distribution range, and the availability of information that has been accumulated in previous studies on the species.

Bionomics. Species of the subgenus *Coprochara* occur predominantly in the dung of herbivorous vertebrates and in a wide range of organic materials (Klimaszewski & Jansen, 1994). *Aleochara verna* is considered as inhabiting in the same environment. Adults were collected from human feces and other animal droppings such as cow, horse, dog, and woodchuck, as well as carrion (Klimaszewski, 1984). The first author collected the species from cow dung in a pasture at Aso, Kumamoto Prefecture, Japan. He also confirmed that *A. verna* was attracted to small prawns (leavings from a packed lunch) on a walkway in 2009 at Mt. Sobo, Japan. SY also collected specimens of this species on a walkway in summer 2011 on the same mountain, and observed dozens of individuals walking actively on rocks and pebbly surface on the summit (Fig. 42: arrow).

The altitudinal range of *A. verna* is quite wide. Klimaszewski (1984) noted that adult specimens were collected at altitudes from less than 200 m to nearly 4,000 m. Japanese specimens were found at altitudes from 0 (seashore) to over 2,000 m.

Host records. Comprehensive dipteran host records for *A. verna* were provided by Maus *et al*. (1998). This paper gives the following four families as its hosts: Anthomyiidae, Scathophagidae, Muscidae, and Sarcophagidae.

Aleochara (*Coprochara*) *binotata* Kraatz, 1856

Figs. 2, 8, 10, 22, 29, 44

Aleochara (*Coprochara*) *binotata*; Kraatz, 1856: 106 (original description); Klimaszewski, 1984: 22; Lohse, 1986: 95; Lohse, 1989: 237; Welch, 1990: 225; Welch, 1997: 4, 14, 34; Maus, 1998: 91, 96; Maus *et al*., 1998: 240; Maus & Ashe, 1998 (online); Maus *et al*., 2001: 206; Smetana, 2004: 355; Assing & Schülke, 2006: 95; Gouix & Klimaszewski, 2007: 25.
Aleochara sahlbergi Eppelsheim, 1833: 39. [replacement name].
Aleochara longula Heer, 1839: 318.
Baryodma incrassata Thomson, 1860: 255.
Aleochara notatipennis Hochhuth, 1872: 95.
Baryodma fucicola J. Sahlberg, 1876: 80. [homonym].
Baryodma subtilis J. Sahlberg, 1876: 81.
Aleochara mongolica Likovský, 1965: 54.
"*Aleochara bipustulata*"; Shibata, 1985: pl. 56.

Materials examined. JAPAN: [**Hokkaidô**]: 1 ♂, Yanbetsu-kaigan, Koshimizu-chô, Shari-gun, 29. IV. 2010, T. Katô leg. (KUM); 1 sex?, Sôunkyô, Kamikawa-chô, Kamikawa-gun, 20. VII. 1962, Y. Shibata leg. (cShi); 1 ♂, 2 ♀♀, 1 sex?, Obihiro-shi, 7. VIII. 1980, H. Togawa leg. (KUM); 1 ♀, Zenibako, Otaru-shi, 23. VI. 1977, N. Nishikawa leg. (KUM); 1 ♀, 1 sex?, same locality, but 8. VII. 1977, S.-I. Naomi leg. (KUM); 1 ♀, Orofure-yama (located boundary between Shiraoi-chô and Sôbetsu-chô), 22. VII. 1962, Y. Shibata leg. (cShi); 1 sex?, Iburi (Muroran-shi), 7. X. 1971, K. Miyamori leg. (specimen used in "The Coleoptera of Japan in Color Vol. II" (Shibata, 1985); cWatY, but to be preserved in the collection of the Tokyo University of Agriculture, Atsugi, Japan: TUA).

Other material. GERMANY: [**Rheinland-Pfalz**]: 1 ♂, Ingelheim, 1993, F. Köhler leg. (without collecting date; det. Dr. C. Maus, 1996; genital parts of the specimen is also examined; KUM).

Redescription. Body (Fig. 2): very slender, parallel to subparallel sided, robust, normally moderate in size, ca. 3.58 mm in body length (2.98–4.11 mm, N = 10), and 1.69 mm in fore body length (1.52–2.04 mm, N = 10); dorsal surface strongly glossy. **Color** (Figs. 2, 8–10): ground color dark reddish brown to black; legs, especially tarsal segments, and mouth parts including mandible light brown to reddish brown; most portion of dorsal surface of elytra yellow to rusty yellow but not clearly defined (for Japanese specimens); antennae light brown to reddish brown, surface densely pubescent with minute whitish setae. **Head** (Fig. 2): almost circular (head length = 0.42–0.60 mm (mean = 0.50 mm), head width = 0.45–0.58 mm (mean = 0.53 mm), N = 10), widest at just behind eyes (head width / head length = 1.06, N = 10); dorsal surface covered with long setae sparsely, punctation deep and prominent, only small numbers scattered. **Antennae** (Fig. 2): moniliform, elongated like long club, short, not reaching to middle of head and pronotum combined (antenna length = 0.66–0.97 mm (mean = 0.80 mm), N = 10); segment I, about 2.4 times longer than width, segment II slightly shorter than I, segment III slightly shorter than II, segments IV spherical, as long as width except for stem of segment, segment V clearly wider than long, segments VI to X, strongly transverse, segment XI thick and subconical, nearly 1.4 times as long as width, almost same length as segment I, approximate relative length of segments from basal to apex: 11.5: 8.5: 7.0: 4.0: 4.0: 4.0: 4.0: 4.0: 4.0: 4.0: 12.0. **Thorax**: pronotum (Fig. 2) moderately transverse (pronotum length = 0.53–0.68 mm (mean =

0.61 mm), pronotum width = 0.65–0.87 mm (mean = 0.77 mm), pronotum width / pronotum length = 1.26 (mean), N = 10), wider than head (pronotum width / head width =1.45 (mean), N = 10), widest around middle; surface coarsely but deeply punctured, with strongly impressed longitudinal rows of punctures along midline. Intercoxal process of mesoventrite (Fig. 10) with strong carina along midline. Metaventrite (Fig. 10) smooth, inconspicuous compared to that of elytra. Intercoxal process of metaventrite (Figs. 9–10) moderately broad and weakly pointed apically. Elytra (Fig. 8) wider than long (elytra length = 0.47–0.68 mm (mean = 0.58 mm), elytra width = 0.77–1.01 mm (mean = 0.91 mm, N = 10) with large yellowish portion except for anterior margin of pronotum (for Japanese specimens); surface deeply punctured, covered with conspicuous setae; posterior margin weakly rounded posteriorly. **Legs** (Fig. 2): short (hind tibia length = 0.40–0.55 mm (0.50 mm), N = 10), dozens of long spines on fore and midtibia, respectively; relative lengths of tarsal segments from basal to apical: 4.0: 3.0: 3.0: 2.5: 8.5 in foretarsus, 8.5: 4.5: 4.5: 4.0: 11.0 in midtarsus, 12.5: 7.0: 5.0: 5.0: 12.0 in hindtarsus. **Abdomen** (Fig. 2): weakly glossy, covered by short but thick setae.

[Male]: posterior margin of tergite VIII (Fig. 22) weakly serrate or almost truncate, with approximately 6 macrosetae on each side. Posterior margin of sternite VIII (Fig. 24) pointed triangularly, with approximately 6 macrosetae. Median lobe of aedeagus as in Figs. 26–27: elongated and narrowed toward apex; flagellum shorter, at most as long as median lobe of aedeagus; basal plate of flagellum long and large; sclerite Y narrowly elongated; sclerite Z with straightly projecting attachment on apex; apical lobe in lateral view weakly bent, sharply pointed; triangular-shaped in ventral view; apical lobe looks long isosceles. Apical lobe of paramerite (Fig. 28) straight, long and slender, bearing with short 4 setae; surface covered with numerous minute setae.

[Female]: tergite VIII (Fig. 23) with weakly serrate posterior margin, with 4 macrosetae. Sternite VIII (Fig. 25) rounded to weakly pointed posteriorly, with approximately 4 macrosetae. Spermatheca (Fig. 29): apical invagination of spermatheca large and deep; spermathecal head spherical, fused with spermathecal neck; attachment of spermathecal duct prominent; (sn) slightly narrowing toward basal portion of spermathecal stem; coiled portion long, composed of maximally 20 times of thick coils, extended laterally, directly connected with thick membranous portion of spermathecal duct; each part of spermatheca except for (sm) entirely and moderately sclerotized; inner wall of (sh) finely striate.

Diagnosis. *Aleochara binotata* is similar to the other species of the Japanese *Coprochara*, especially *A. verna*, but can be easily distinguished from them as follows: body clearly slender, surface smooth and glossy in dark reddish brown to black, usually paler than *A. verna* (Fig. 2); posterior margin of elytra rounded with huge yellowish portion on elytra (Figs. 1, 8); pronotum with prominent rows of punctures along midline; intercoxal process of metaventrite moderately pointed apically (Fig. 10); tergite VIII without thick spines in posterior half (Figs. 22–23). [**Male**]: apical lobe of median lobe of aedeagus sharply pointed; flagellum short; sclerite Z with short attachment (Figs. 26–27). Apical lobe of paramerite long, straight, bearing short 4 setae and numerous minute setae (Fig. 28). [**Female**]: spermatheca consisted with around 20 thick coils, greatly extended laterally (Fig. 29).

Confirmed distribution by present study. [**JAPAN**]: Hokkaidô.

Other localities in literature. [**EUROPE**]: Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Russia: North European Territory, Slovakia, Sweden, UK, Ukraine (Smetana, 2004), [**NORTH AFRICA**]: Canary and Madeira Islands (Smetana, 2004; Assing, 2006), [**ASIA**]: Mongolia, Russia (east and west Siberia), Yemen (Smetana, 2004).

Remarks. This species was described from northern Germany, and its distribution is confined to the Palearctic region. The present paper provides the first record of *A. binotata* from Japan (Hokkaidô). This species seems to be rare and only 11 Japanese specimens were examined. In England, where the yellow-spotted species of the subgenus, *A. verna*, has a wide distribution but *A. binotata* is much rarer (Welch, 1997). The same pattern might occur in Japan.

The taxonomical history is rather complicated due to morphological similarities among *A. bipustulata*, *A. verna*, and *A. binotata* (see remarks of *A. verna*). We reexamined the specimen that was used in the aleocharine plate of "The Coleoptera of Japan in Color Vol. II" (Shibata, 1985), which was introduced as *A. bipustulata*. In fact, we found that the specimen was a misidentification of *A. binotata*.

Maus (1998) designated the female lectotype of *A. binotata*. Welch (1997) provided a diagnostic key with precise figures and informative notes.

The Japanese specimens had uniformly lighter colored elytra and the German specimen used in this study was much darker. This yellowish elytra well agreed with Klimaszewski (1984: 24; as the European concept of *A. verna* type II) and Welch (1997). The configuration of male genitalia also showed no morphological differences when

compared with specimens from Germany. Thus, elytral coloration can be regarded as color variation within *A. binotata*.

Bionomics. No information is available for Japanese individuals.

Host records. The following seven dipteran families are known hosts (Maus *et al*., 1998): Ulidiidae, Piophilidae, Lonchaeidae, Anthomyiidae, Muscidae, Calliphoridae, and Sarcophagidae. However, host records based on references before Lohse (1986) are not reliable (Welch, 1997).

Aleochara (*Coprochara*) *squalithorax* Sharp, 1888

Figs. 3, 4, 11, 13, 30, 41, 43, 45

Aleochara (*Coprochara*) *squalithorax*; Sharp, 1888: 282 (original description); Adachi, 1957: 34; Naomi, 1989: 280; Assing, 1995: 235; Maus, 1998: 84, 98; Maus & Ashe, 1998 (online); Ahn *et al*., 2000: 244; Maus *et al*., 2001: 206; Park & Ahn, 2004: 196; Smetana, 2004: 356; Frank & Ahn, 2011: 19; Yamamoto & Maruyama, 2012: 5, 11.

Type specimens. [**Lectotype**]: ♂, "Aleochara / squalithorax / Type D.S. / Hakodate / Lewis [PC, HW] // Type [RRL] // Hakodate. // Japan. / G. Lewis // Sharp Coll. / 1905-313 // Lectotypus / design. Assing 1994 // Lecto- / type [PRL]" (abdominal segment VIII-X and aedeagus are dissected and glued on a PC together with the body). Paralectotypes, 1 ♀, 2 sex?, "Aleochara squalithorax / Fauvel. / Hagi. Japan [HW] // SYN- / TYPE [BRL] // Japan. / G. Lewis // Sharp Coll. / 1905-313 // Para- / lecto- / type [BRL]" (three specimens are mounted in the same PC).

Materials examined. JAPAN: [**Hokkaidô**]: 6 sex? (GT), 2 sex? (YT), Hamamatsu, Nemuro-shi, 14. VI. 2010, S. Yamamoto leg. (from dry seaweed on huge sandy beach; cYam); 2 sex? (GT), Ochiishi, Nemuro-shi, 24. VIII. 1999, M. Maruyama leg. (KUM); 55 sex? (GT), Sanriga-hama, Ochiishi, Nemuro-shi, 12. VI. 2010, S. Yamamoto leg. (from completely dry seaweed on huge sandy beach; cYam); 19 sex? (GT), Urayakotan, Hamanaka-chô, Akkeshi-gun, 12. VI. 2010, S. Yamamoto leg. (from somewhat wet seaweed on sandy beach; cYam); 1 ♂ (GT), Zenibako, Otaru-shi, 30. V. 1977, N. Nishikawa leg. (KUM). [**Honshû**]: 4 sex? (GT), Gouya-kaigan, Yotsugouya, Nishi-ku, Niigata-shi, Niigata-ken, 4. V. 1996, K. Haga leg. (under rubbish on sandy beach; cHaga); 13 sex? (GT), Kanayama, Teradomari, Nagaoka-shi, Niigata-ken, 3. V. 2004, M. Nishikawa leg. (KUM); 2 sex? (GT), Uchinada-machi, Kahoku-gun, Ishikawa-ken, 15. VI. 1961, Y. Hayashi leg. (cHay); 1 sex? (GT), Awagasaki, Uchinada-machi, Kahoku-gun, Ishikawa-ken, 12. V. 1948, S. Takaba leg. (cHay); 1 ♀ (GT), 1 sex? (GT), Hasaki-kaigan, Kamisu-shi, Ibaraki-ken, 13. X. 2009, H. Ono leg. (sandy beach; cOno); 1 ♂ (GT), 2 ♀♀ (GT), 1 sex? (GT), same data, but 19. X. 2009; 2 ♂♂ (GT), 3 ♀♀ (GT), 1 sex? (GT), same data, but 29. X. 2009; 1 ♂ (GT), 2 ♀♀ (GT), 5 sex? (GT), Ôami, Chiba-ken, 1. V. 1990, M. Ôhara leg. (KUM); 2 ♂♂ (GT), 4 ♂♂ (YT), 3 ♀♀ (GT), 1♀ (YT), 7 sex? (GT), river mouth of Ichinomiya-gawa, Hitotsumatsu, Chôsei-mura, Chôsei-gun, Chiba-ken, 16. V. 1993, T. Takeda leg. (KUM); 2 sex? (GT), Ôhara-kaigan, Ôhara, Isumi-shi, Chiba-ken, 30. V. 1992, H. Oda leg. (KUM); 13 sex? (GT), 2 sex? (YT), Hebara, Katsuura-shi, Chiba-ken, 12. V. 1991, T. Takeda leg. (KUM); 2 ♂♂ (YT), 20 sex? (GT), 15 sex? (YT), Katsuura, Katsuura-shi, Chiba-ken, 4. V. 1990, T. Takeda leg. (KUM); 1 ♀ (YT), 10 sex? (GT), Ubara, Katsuura-shi, Chiba-ken, 6. IV. 1993, T. Takeda leg. (KUM); 1 ♂ (GT), Heisaura, Sakai, Tateyama-shi, Chiba-ken, 13. VIII. 1993, T. Takeda leg. (KUM); 1 ♂ (YT), 1 ♀ (GT), 18 sex? (GT), 5 sex? (YT), same locality, but 1. IV. 1997, M. Maruyama leg. (KUM); 1 sex? (GT), Shinmaiko-kaigan, Yawata, Futtsu-shi, Chiba-ken, 11. VI. 1995, K. Emoto leg. (cWat); 1 sex? (GT), Arasaki, Nagai, Yokosuka-shi, Kanagawa-ken, 12. VI. 2009, T. Watanabe leg. (cWat); 6 sex? (GT), Hayama-machi, Miura-gun, Kanagawa-ken, 28. III. 1954, R. Kiryû leg. (SCM); 1 ♂ (GT), Yuiga-hama, Kamakura-shi, Kanagawa-ken, 5. IX. 1976, Niizato leg. (without collector's given name; KUM); 4 sex? (GT), Shichiriga-hama, Kamakura-shi, Kanagawa-ken, 20. IV. 1991, K. Haga leg. (cHaga); 1 sex? (GT), same locality, but 6. V. 1991, Y. Ueda leg. (cWat); 1 ♂ (GT), Tujidô-kaigan, Tujidô, Fujisawa-shi, Kanagawa-ken, 31. V. 1986, T. Watanabe leg. (under seaweed cast on shore; cWat); 1 ♀ (GT), Tujidô, Fujisawa-shi, Kanagawa-ken, 3. V. 1995, T. Watanabe leg. (under seaweed cast on shore; cWat); 14 sex? (GT), Shônan-kaigan, Kanagawa-ken, 2. VII. 1976, Niizato leg. (without collector's given name; KUM); 8 sex? (GT), Shirahama, Shirahama, Shimoda-shi, Shizuoka-ken, 13. III. 1989, H. Oda leg. (KUM); 1 ♂ (GT), Mihama, Maizuru-shi, Kyôto-fu, 3. V. 1980, Y. Hayashi leg. (cHay); 1 sex? (GT), Kanzaki-kaisuiyokujô swimming beach, Nishikanzaki, Maizuru-shi, Kyôto-fu, 2. IV. 2000, M. Yoshii leg. (cHay); 4 sex? (GT), Amino-chô-hamazume, Kyôtango-shi, Kyôto-fu, 21. V. 2000, K. Yasukawa leg. (cHay); 4 sex? (GT), 1 sex? (YT), Kumihama-chô-minatomiya, Kyôtango-shi, Kyôto-fu, 17. IV. 2000, H. Nagata (Osada?) leg. (cHay); 1 ♂ (GT), Koura-kaigan, Kashima-chô,

Matsue-shi, Shimane-ken, 17. VII. 2010, S. Yamamoto leg. (under dry flotsam on sandy beach; cYam); 1 ♂ (GT), 1 ♀ (GT), 5 sex? (GT), Taki-chô, Hikawa-gun, Shimane-ken, 2. VI. 1980, S.-I. Naomi leg. (KUM). [**Kyûshû**]: 5 ♂♂ (GT), 1 ♂ (YT), 2 ♀♀ (GT), 1 ♀ (YT), 122 sex? (GT), 17 sex? (YT), Watari, Fukutsu-shi, Fukuoka-ken, 21. IV. 2012, S. Yamamoto, M. Maruyama, T. Kanao leg. (from dry to wet seaweed on huge sandy beach; KUM); 5 sex? (GT), 3 sex? (YT), Watari, Fukutsu-shi, Fukuoka-ken, 21. IV. 2012, S. Yamamoto, M. Maruyama, T. Kanao leg. (from dry to wet seaweed on small sandy beach; KUM); 1 ♂ (YT), 1 ♀ (YT), 4 sex? (GT), 1 sex? (YT), Mitoma, Higashi-ku, Fukuoka-shi, Fukuoka-ken, 3. VI. 2001, S. Ogata leg. (KUM); 2 sex? (GT), Katsuma (Shikano-shima), Higashi-ku, Fukuoka-shi, Fukuoka-ken, 21. III. 2012, S. Yamamoto leg. (from seaweed on huge sandy beach; cYam); 1 sex? (GT), Karatsu-shi, Saga-ken, 7. VII. 1975, H. Ohishi leg. (KUM); 2 sex? (GT), Minamiôsumi-chô (Sata-misaki), Kimotsuki-gun, Kagoshima-ken, 28. V. 1958, Y. Miyake leg. (cHay); 1 ♀ (GT), 11 sex? (GT), Nakatane-chô (Tanega-shima), Kumage-gun, Kagoshima-ken, 8-13. V. 1996, M. Maruyama leg. (KUM).

Redescription. Body (Figs. 3–4): thick and spindle shaped, especially for small individuals (Fig. 4), small to medium sized, ca. 3.48 mm in body length (3.14–3.83 mm, N = 15), and 1.88 mm in fore body length (1.68–2.15 mm, N = 15), normally moderate in size; entire body heavily robust; dorsal surface mat; forebody covered with granular microstructures. **Color** (Figs. 3–4, 11–13): ground color gray to blackish brown; legs, especially tarsal segments, and mouth parts dark brown to reddish brown; elytra gray in most cases as Fig. 3, but some individuals with huge yellowish portion except for anterior and lateral margins as Fig. 4; antennae reddish brown to dark brown, surface densely pubescent with minute yellowish setae. **Head** (Figs. 3–4): circular (head length = 0.42–0.56 mm (mean = 0.48 mm), head width = 0.46–0.56 mm (mean = 0.51 mm), N = 15), slightly transverse (head width / head length = 1.08 (mean), N = 15), widest at eyes; surface entirely covered with hexagonal reticulations, lacking punctation, but covered with short and thick setae sparsely. **Antennae** (Figs. 3–4): moniliform, robust and thickened apically, slightly longer than head length (antenna length = 0.57–0.84 mm (mean = 0.73 mm), N = 15); segment I, about 2.1 times as long as broad, segment II slightly shorter than I, segment III apparently shorter than II, segments IV to VI more or less spherical, as long as width except for stem of each segment, segment VII moderately wider than long, segments VIII to IX clearly transverse, segment X strongly transverse, segment XI thick and conical, nearly 1.2 times as long as width, as same length as segment I, approximate relative length of segments from basal to apex: 10.5: 10.0: 6.0: 4.5: 4.5: 4.5: 4.5: 4.5: 4.5: 4.5: 10.5. **Mouth parts** (Figs. 30–33): mandibles slightly asymmetric, left one with one tooth near apex. Clypeus rounded apically. Labrum (Fig. 32) transverse, about 1.3 times as wide as long, anterior margin slightly emarginated medially, basal half semi-transparent, apodeme roundly produced postero-medially; surface with numerous pseudopores scattered randomly in apical part. Ligula (Fig. 30) bilobed, with each lobe rounded apically. Labial palpus (Fig. 30) with segment I thicker and longer than II, segment II weakly dialated, segment III shorter than II. Mentum (Fig. 33) nearly trapezoidal, much wider than long, about 2.0 times as wide as long; anterior margin strongly emarginated; entire surface with numerous pseudopores scattered randomly. Maxilla (Fig. 31): maxillary palpus with thick and long segment II and III, segment II as long as III, segment IV short, less than half length of segment III; galea thick and short, clearly shorter than segment II of maxillary palpus; lacinia with numerous setae and with dozens of thick spines pectinately. **Thorax**: pronotum (Figs. 3–4) transverse (pronotum length = 0.60–0.76 mm (mean 0.69 mm), pronotum width = 0.77–0.94 mm (mean = 0.88 mm), pronotum width / pronotum length = 1.27 (mean), N = 15), clearly wider than head (pronotum width / head width = 1.71 (mean), N = 15), widest around basal 1/3, weakly narrowing apically; surface uniformly covered with large hexagonal reticulations, thick-short setae but without distinct punctation; midline longitudinally elevated weakly above, glabrous, lacking punctation. Intercoxal process of mesoventrite (Fig. 13) with strongly developed carina along midline. Intercoxal process of metaventrite (Figs. 12–13) narrow and long, apparently pointed apically. Metaventrite (Fig. 13) rough, densely pubescent like elytra. Elytra (Figs. 3–4, 11) wider than long (elytra length = 0.62–0.78 mm (mean = 0.68 mm), elytra width = 0.90–1.13 mm (mean = 1.04 mm), N = 15), rugose, moderately covered with yellowish thick and short setae; posterior margins deeply notched laterally (Fig. 11); [Gray type]: dorsal surface entirely gray, but [Yellow type]: with a pair of large yellowish portions, extending from apical to posterior except for anterior margins and shoulders close to pronotum as well as lateral margins of elytra and elytral suture (posterior margins colored). **Legs** (Figs. 3–4): short (hind tibia length = 0.49–0.65 mm (mean = 0.57 mm), N = 15) and thick, dozens of thick spines on tibia, especially on fore and midtibia; relative lengths of tarsal segments from basal to apical: 5.0: 3.5: 3.5: 3.0: 8.0 in foretarsus, 8.0: 5.0: 5.0: 4.5: 14.5 in midtarsus, 17.5: 10.0: 7.0: 7.0: 14.5 in hindtarsus. **Abdomen** (Figs. 3–4): rogose, except for anterior margin of each tergite and posterior margin of tergite VI to VII; tergite VIII (Figs. 34–35) with dozens of thick spines scattered in posterior half.

[Male]: posterior margin of tergite VIII (Fig. 34) rounded, with approximately 7 macrosetae on each side. Sternite VIII (Fig. 36) with one macroseta (difficult to identify); posterior margin weakly pointed. Median lobe of aedeagus as in Figs. 38–39: compactly elongated and narrowed toward apex; flagellum long, clearly longer than median lobe of aedeagus; sclerite Y large; sclerite Z large without attachment at apex; apical lobe in lateral view slightly bent, narrowing subapically, median lobe in ventral view elongated, weakly narrowing toward apex; basal swelling of median lobe large and oval; apical lobe looks short isosceles. Apical lobe of paramerite (Fig. 40) short and thick, widest at subapical portion, bearing 4 setae.

[Female]: tergite VIII (Fig. 35) with rounded posterior margin like male, with approximately 4 macrosetae. Posterior margin of sternite VIII (Fig. 37) weakly pointed, with one macroseta (difficult to confirm). Spermatheca (Fig. 41): apical invagination of spermatheca tiny and shallow; spermathecal head fused with spermathecal neck; attachment of spermathecal duct prominent; (sn) short, slightly narrowing toward basal portion of spermathecal stem; coiled portion extremely long, composed with countless times of moderately thick coils, not extended laterally, waving toward membranous portion of spermathecal duct; coils directly connected with thick (sm); each part of spermatheca except for (sm) entirely and strongly sclerotized; inner wall of (sh) coarsely and that of (sb) in apical portion also coarsely striate with rough mesh striate in mid to posterior part of (sb).

Diagnosis. *Aleochara squalithorax* can be easily distinguished from the other *Coprochara* in Japan by a combination of the following character states: body thick and spindle shaped; surface mat with granular microstructures, covered with thick and short setae coarsely but without punctation on head and pronotum (Figs. 3–4); pronotum clearly wider than head, without rows of punctures along midline; elytra with posterior margin deeply notched, sometimes with yellowish portion on dorsal surface (YT: Figs. 4, 11); intercoxal process of metaventrite narrow and sharply pointed apically (Fig. 13); tergite and sternite VIII with thick spines in posterior half (Figs. 34–35). [**Male**]: flagellum long; sclerite Z large without attachment (Figs. 38–39); apical lobe of paramerite short, thick, without numerous minute setae (Fig. 40). [**Female**]: countless coiled portion with spermatheca (Fig. 41).

Confirmed distribution by the present study. [**JAPAN**]: Hokkaidô, Honshû, Kyûshû, Tanega-shima.

Other localities in the literature. [**EAST ASIA**]: South Korea (Ahn *et al*., 2000; Park & Ahn, 2004).

Remarks. *Aleochara squalithorax* is a rather common species in Japan but has a limited distribution globally. Until now, this taxon has only been recorded from Japan and South Korea (Smetana, 2004; Frank & Ahn, 2011). A recent study provided the first record of *A. squalithorax* from South Korea and briefly redescribed the species and provided a figure of the median lobe of the aedeagus of the male, based on Korean specimens (Ahn *et al*., 2000). The distribution of *A. squalithorax* in Japan is wide, from northeastern Hokkaidô (Nemuro) to southwestern Kyûshû (Tanega-shima). We provide new distributional records from mainland Kyûshû.

This species is considered a highly derived taxon of the subgenus *Coprochara* and it has attracted special attention from researchers (Bernhauer & Scheerpeltz, 1926; Assing, 1995; Maus, 1998). Thus, the line drawings of mouth parts, which are important characters in Aleocharinae that have never been described, are also provided in this paper.

Historical notes. This species was originally described as "*Aleochara squalithorax*" from "Hagi [Hagi-shi, western end of Honshû, Japan] (*Fauvel*), Hakodate [Hakodate-shi, Hokkaidô, Japan] (*Lewis*)" by Sharp (1888). Afterward, Fenyes (1920) included it within the peculiar subgenus *Eucharina* Casey, 1906. A few years later, Bernhauer and Scheerpeltz (1926) transferred *A. squalithorax* to the newly established subgenus *Skenochara* Bernhauer & Scheerpeltz, 1926 as the type species, and it was the only species assigned to *Skenochara*. Assing (1995) raised this subgenus to generic rank (still only one species remained in the taxon). This paper was especially important because *A. squalithorax* was redescribed with figures and the male lectotype was designated. The systematic position of *Skenochara* was unclear, although Assing (1995) tentatively treated it as a distinct genus.

Maus and Ashe (1998) and Maus (1998) detected *Skenochara* with all apomorphies that characterize the subgenus *Coprochara*; i.e., the existence of dorsal longitudinal rows on the pronotum, a strongly coiled spermatheca in the female, and a completely carinate mesoventrite. Therefore, *Skenochara* was synonymized under the subgenus *Coprochara* by Maus (1998). In addition to morphological evidence, molecular information supported this treatment (Maus *et al*., 2001; see Phylogeny of *A. squalithorax*).

Bionomics. SY and MM collected the species at several different locations in Hokkaidô, Honshû and Kyûshû that faced both the Pacific Coast and the Sea of Japan (Fig. 45). All of the locations were sandy beaches, none of the areas were very small, and they generally had good environmental conditions (Fig. 43). Individuals were found from completely dry seaweed masses on beaches that were far from the shoreline from sites that were and close to

coastal vegetation at Hamamatsu and Urayakotan in Hokkaidô; specimens were also collected from somewhat wet seaweed at Watari, Kyûshû (Fig. 43). Adults were observed and collected from early spring (March) to mid-fall (October), with the highest number of individuals being observed between April and May.

Host records. No information is available for *A. squalithorax*.

Phylogeny. Phylogenetic trees in Maus *et al*. (2001) show relationships among *A. verna*, *A. binotata*, and *A. squalithorax*. All three species were included in the *Coprochara* clade. *Aleochara squalithorax* formed a sister group with littoral *A.* (*C.*) *sulcicollis* Mannerheim, 1843 from North America. Microsculpture is present in *Emplenota*, *Maseochara*, *Polystomota*, and *A. squalithorax*, but none of the analyses supported a monophyletic clade of these taxa (Maus *et al*., 2001).

Color variation in elytra. Two patterns of elytral color variation were found. The gray type (Fig. 3) is apparently the typical form and the yellow type (Figs. 4, 11) is much rarer. We examined both types morphologically, but no differences were found between the two types. Thus, the authors concluded that the difference represents color variation within *A. squalithorax*. The yellow type accounted for only 12.6% of the total number of individuals collected (N=470). The ratio also showed considerable variation among locations. For example, no yellow-type individuals were found among 55 specimens at Sanriga-hama in Hokkaidô. In contrast, the yellow type accounted for 14.1% in Watari (data combined across small and large beaches), Kyûshû (N=156), and the highest ratio, 45.9%, was recorded in Katsuura, Honshû (N=37).

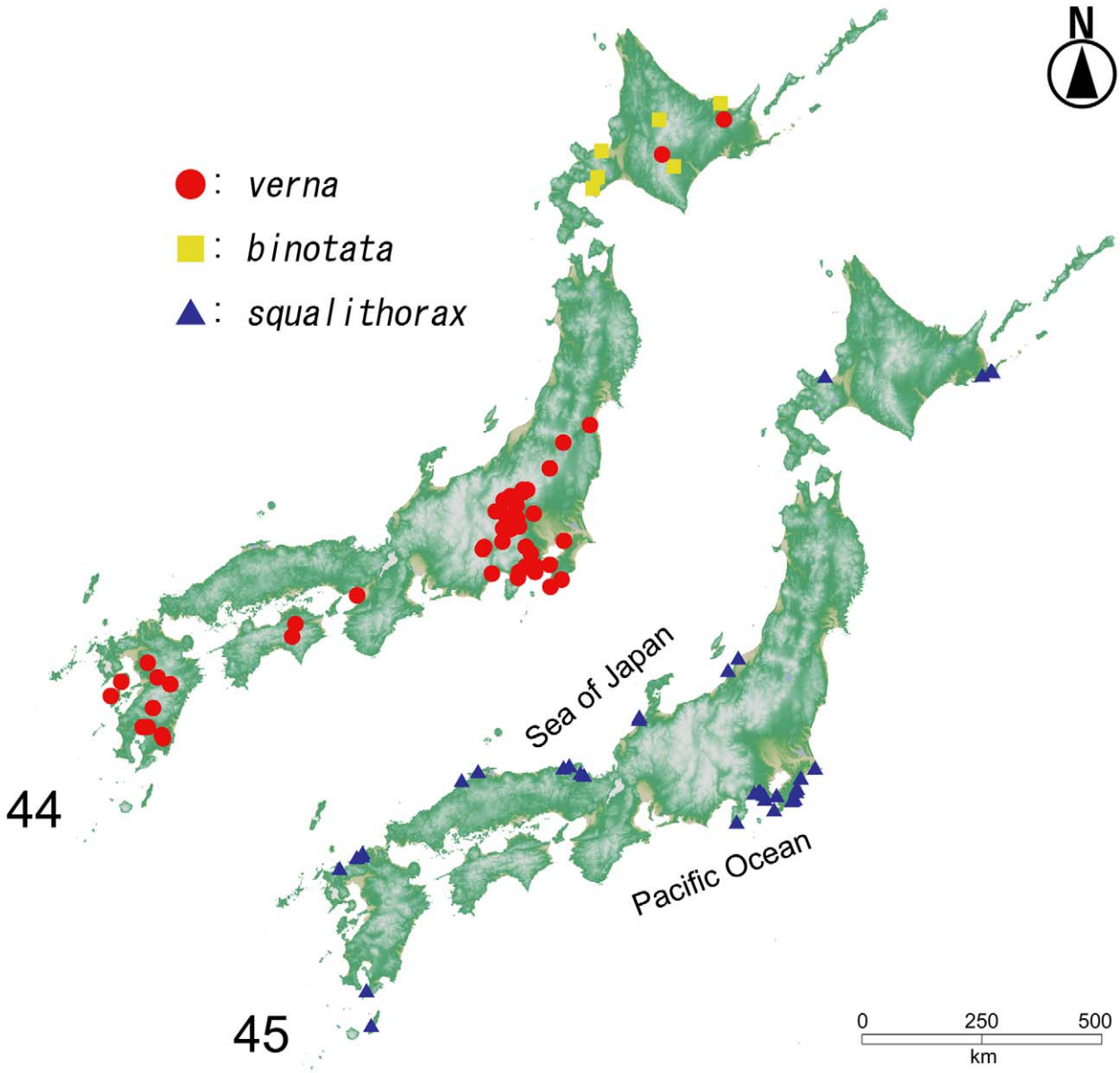
FIGURES 42–43. Habitats of the subgenus *Coprochara* of the genus *Aleochara* in Japan. 93. the summit of Sobo-san (located in boundaries between Ôita and Miyazaki Prefectures; only observed; *A.* (*C.*) *verna*: arrow); 43. Watari (Fukutsu, Fukuoka Prefecture; *A.* (*C.*) *squalithorax*: arrow).

Discussion

Does *Aleochara bipustulata* occur in Japan?

As a yellow-spotted *Aleochara* species, *Aleochara* (*Coprochara*) *bipustulata* (Linnaeus, 1760) was thought to be a very common species in Japan. The first record of *A. bipustulata* in Japan was given by Sharp (1888) as *A. nitida* Gravenhorst, 1802, which was later synonymized under *A. bipustulata*. Adachi (1957) recognized *A. bipustulata* in his catalog of Japanese rove beetles. Naomi (1989) and Smetana (2004) followed this treatment. However, we examined more than 250 Japanese specimens that have hitherto been identified as *A. bipustulata*, and no specimen of *A. bipustulata* was found. These specimens were identified as *A. verna* Say, 1833 or *A. binotata* Kraatz, 1856. In conclusion, we exclude *A. bipustulata* from the Japanese insect fauna.

The confusions of *A. bipustulata* in North America addressed in Hemachandra *et al*. (2005) and addressed in Europe in Welch (1997) illustrate some of the taxonomic difficulties that have been encountered with the species. Maus (1998) identified the distribution pattern of *A. bipustulata*, which includes all of Europe through North Africa to Pakistan and India. Therefore, the South Korean record of *A. bipustulata* in Cho and Ahn (2001) is highly doubtful. Park *et al*. (2011) recorded *Aleochara verna* for the first time from South Korea; therefore, the South Korean record of *A. bipustulata* might be a misidentification of *A. verna*. Further study in East Asia is needed to evaluate the true diversity of the subgenus *Coprochara* in the region.



FIGURES 44–45. Collecting localities of *Aleochara* (*Coprochara*) spp. based on specimens examined in Japan. 44. *Aleochara* (*Coprochara*) *verna* (Indicated by red circle) and *A.* (*C.*) *binotata* (Indicated by yellow square); 45. *A.* (*C.*) *squalithorax* (Indicated by blue triangle).

Examined specimen data of *Aleochara bipustulata*. AUSTRIA: [**Burgenland**]: 1♂, 1♀, Illmitz, VI. 1995, K. Peschke leg. (without collecting date; det. Dr. C. Maus, 1996; KUM).

Genital parts of both sexes were examined. This species is distinguished from *A. verna* and *A. binotata* by a much smaller coiled portion (1–5 coils) of the female spermatheca and the shape of a sclerite Z inside the median lobe of the aedeagus in the male (Maus, 1998).

Diversity and distribution

We recognized only three species as Japanese congeners of the subgenus *Coprochara*. This number is much smaller than the species counts in USA (seven species: Klimaszewski, 1984) and South Africa (six species: Klimaszewski & Jansen, 1994). However, it is very close to the number of the species in UK (four species: Welch, 1997) and South Korea (three species, although *A. bipustulata* is doubtful: Ahn *et al*., 2000; Cho & Ahn, 2001; Park *et al*., 2011).

Two species, *A. verna* and *A. binotata*, have wide global distribution ranges, but *A. squalithorax* is confined to East Asia. *Aleochara verna* is a Holarctic species and its presence in Japan is not surprising. In contrast, the finding of *A. binotata* from Japan is quite unexpected. This species has mainly been recorded from Europe. Previously, the easternmost record of this species was from east Siberia (Smetana, 2004). For that reason, the Japanese specimens represent the easternmost records of *A. binotata*. All of the Japanese specimens of this species were collected from Hokkaidô located in northeastern Japan, which has a continental climate (Fig. 44).

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APPENDIX

APPENDIX 1. Species list of Japanese names of *Aleochara* (subgenus *Coprochara*).

Subgenus *Coprochara* Mulsant & Rey, 1874	
Scientific name	Japanese name
Aleochara (*Coprochara*) *verna* Say, 1833	Futamon-higebuto-hanekakushi
A. (*C.*) *binotata* Kraatz, 1856	Kibane-higebuto-hanekakushi
A. (*C.*) *squalithorax* Sharp, 1888	Futo-tsuyakeshi-higebuto-hanekakushi